EXAMINATION OF THE ASSOCIATION BETWEEN PERSONAL VALUES, LIFESTYLE FACTORS, AND WEIGHT LOSS IN A BEHAVIORAL PROGRAM

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Individual level values have been suggested as a construct that may influence motivation and adherence to health behavior change. There has been limited research conducted to examine values within the context of a behavioral weight loss intervention to treat overweight and obesity.

PURPOSE: The purpose of this study was to examine the association between the perception of how engagement in a weight loss intervention would influence values and actual change in weight and weight loss-related behaviors (eating and physical activity).

METHODS: Data utilized within the analyses were from participants enrolled in a 6-month behavioral weight loss intervention. Baseline data were available on 67 participants (age = 44.2±9.0 years; body mass index [BMI] = 32.6±3.9 kg/m^2) with 58 subjects providing data on values at 6 months (age = 43.9±9.2 years; BMI = 32.6±4.0 kg/m^2). Objective measures were taken at baseline and 6 months for body weight and BMI, with questionnaires used to assess values, perceived impact that engaging in a weight loss intervention would have on values, dietary intake (kcal/day), eating behaviors for weight loss, and physical activity (kcal/week).

RESULTS: Marriage/couples/intimate relationships, family, and parenting were the three highest ranked values at both baseline and 6 months, suggesting that values remained relatively stable over the course of the weight loss intervention. There was no significant relationship between participant's perception of the impact that engaging in a weight loss intervention would have on their values (measured at baseline and 6 months) and their actual changes in body weight, and related eating and physical activity behaviors.

DISCUSSION: This study found no significant association between either weight loss or weight loss related behaviors (eating, physical activity) and perception of how these efforts impacted values of participants. These findings are not consistent with theories that have suggested that values can be important to elicit health behavior changes. However, these findings do not indicate that values-based interventions will not be effective for weight loss because values were not specifically targeted within the intervention. Therefore, additional research is needed to understand how values may influence health-behavior change, specifically within the context of a weight loss intervention.

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PREFACE

I would like to dedicate this project to my Lord and Savior Jesus Christ. Father, thank you that your plans for me always outweigh my own. I look forward to seeing how you use this career for your honor and glory. I would also like to express my gratitude to my dissertation committee Drs. Michelle Levine, Bethany Barone Gibbs, Sharon Ross, Kelliann Davis, and John Jakicic. Your support and guidance through the development and completion of this project is greatly appreciated. I would like to particularly extend my deepest gratitude to my co-chairs, Drs. Kelliann Davis and John Jakicic. Dr. Davis, your patience, encouragement, and grace as a professor and mentor is truly remarkable. I can't thank you enough for the way in which you challenged and guided me throughout this project. You have inspired me to seek excellence in all that I do in this field. Dr. Jakicic, I cannot thank you enough for seeing potential in me and offering me this profound opportunity to study under your mentorship. Your guidance and support has ignited a passion within myself for a career in this field. I will be forever grateful.

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and friends thank you for your prayers, encouragement, and gracious understanding for all those events I had to miss in order to reach this milestone. I look forward to all the memories we will make as this journey of life continues.

1.0 INTRODUCTION

Obesity is a public health epidemic ranking as the fifth leading cause of death globally. Overweight and obesity is defined as having a Body Mass Index (BMI) of 25.0 to < 30.0 kg/m^2 and ≥ 30.0 kg/m^2, respectively.[1-3] According to the World Health Organization (WHO), among the 1.5 billion overweight individuals worldwide, there were 200 million men and 300 million women classified as obese in 2008.[4] Within the United States the current prevalence of overweight among adults over 20 years of age is approximately 68.5%, with 34.9% being obese.[5] Obesity is linked to many chronic diseases such as cardiovascular disease (CVD), diabetes, and various cancers.[6] Additionally, the estimated annual medical care costs of adult obesity in 2010 were approximately $3,508 per individual and $315.8 billion total for the United States.[7]

Due to these health and economic burdens, a national priority is to reduce rates of obesity and promote maintenance of a healthy weight. Healthy People 2020 have set goals for diet, physical activity, and weight control. Specifically, a primary goal is to "improve health, fitness, and quality of life through daily physical activity" by reducing the proportion of individuals who engage in no-leisure-time physical activity, and increasing the proportion of individuals who meet the national guidelines for aerobic and strength training modalities.[8] A second goal is to "promote health and reduce chronic disease risk through the consumption of healthful diets and achieving and maintaining healthy body weights".[8]

Current obesity treatments include bariatric surgery, pharmacotherapy, and lifestyle behavior change programs. [3] The goal of these treatments is to produce a weight loss of at least 5-10% of an individual's initial body weight within the first 6 months of treatment, as this level has been shown to produce significant health benefits by reducing risk factors for various diseases. [3, 9] According to the American College of Cardiology/The Obesity Society 2013 Guidelines for the Management of Overweight and Obesity in Adults, behavioral interventions are recommended for any individual with a BMI $\geq$ 25 kg/m^2 and are to be used in conjunction with bariatric surgery (at a BMI $\geq$40 kg/m^2) and pharmacotherapy (at a BMI $\geq$30 kg/m^2).[3] Lifestyle behavior change interventions produce weight loss through a combination of an energy restricted diet, increased physical activity, and behavior change strategies.[3] Therefore, utilizing these intervention strategies to induce weight loss or prevent further gain in those who are already overweight and obese may result in an overall population reduction of overweight and obesity rates, clinical disease caused by obesity, and healthcare costs related to obesity.

1.1 LIFESTYLE TREATMENT OF OVERWEIGHT AND OBESITY

Regardless of the treatment approach to obesity, the cornerstone of all recommendations includes diet and physical activity prescriptions. It is well known that at a very basic level, the management of body weight is dependent on energy balance. To induce weight loss a negative energy balance needs to be created such that energy expenditure would exceed energy consumed. To elicit this response, intervention strategies focusing on reducing caloric intake and increasing physical activity have been well established. Specifically, a caloric deficit of 500-1000 kcals per day would result in a weight loss of 0.5-0.9kg (1-2lbs) per week.[3, 9-11] Furthermore, it is

recommended that individuals are progressed from 100 to 300 minutes per week of moderate-intensity physical activity to reach an energy expenditure equivalent to ≥2000kcal/week.[3, 9-11] This level of exercise will aid in weight loss and is associated with prevention of weight regain.[3, 10, 12] A final component in the treatment of overweight and obesity is the use of behavioral strategies to aid individuals in the adoption of eating and physical activity behaviors that induce weight loss. Examples of these strategies include problem solving, social support, goal setting, motivation, stimulus control, self-monitoring, and others. [3, 9, 10, 13]

While the combination of caloric restriction, increased physical activity, and behavior change strategies has been shown to be effective in inducing weight loss there is still considerable variability in the amount of weight lost for each individual.[14] Given the variability in initial weight loss it is important to understand the underlying processes that are associated with these differences. Obesity has been described as a chronic condition and is likely the result of a complex relationship between biological, environmental, and behavioral influences.[2, 15] However, it is crucial to examine the correlates associated with successful weight loss.[15] Specifically, identifying characteristics of those who are more likely to respond or not respond to treatment continues to be an important research question.

One key to success in a lifestyle intervention is adherence to the weight loss behaviors such as meeting the diet and physical activity prescriptions, attending the intervention sessions, and using the self-monitoring tools.[15] Research has shown that the individuals who typically experience less success with weight loss and adherence to eating and exercise behaviors tend to perceive and report more barriers than those that are more successful. This relationship can be characterized by looking at the classic cost to benefit ratio.[15] Over time, the perceived cost to adhere to these behaviors begins to outweigh the benefits, resulting in a reduction in the

adherence to weight loss prescriptions. However, research has shown that some individuals are able to adhere to these behaviors even in the presence of multiple barriers. For example, Gallagher et al. revealed that individuals who achieved ≥10% of weight loss and ≥300 min/wk of moderate-vigorous intensity physical activity during a behavioral weight loss intervention reported more obstacle barriers to meeting those recommendations compared to those who only reached 150-199 min/wk of physical activity.[16] The authors explained that even though this group of individuals experienced barriers, they were able to overcome them, and these associations and types of individuals deserve further investigation.[16]

A possible explanation for those individuals who adhere to behaviors even in the face of barriers is the strength of their motivation for change; however, understanding what motivates an individual to adhere to weight loss prescriptions needs further investigation.[15] Specifically, it has been suggested that an individual's values may be a construct that should be explored when determining what underlies motivation and adherence.[17] An individuals' values are often referenced and highlighted within behavioral strategies and theories such as Motivational Interviewing (MI), Acceptance and Commitment Based Therapy (ACT), and Self-Determination Theory (SDT).[18-20] However, the exact values that are important to induce lasting behavior change are not clearly defined and the recommendations to utilize values in intervention are vague. Furthermore, not much is known about the role of values in engagement in diet and exercise behaviors and therefore gaining an understanding of the role of these motivational constructs in the adoption and adherence to weight loss behaviors is warranted.[15] The use of values in current behavioral theories and therapies are detailed below.

1.2 THEORTICAL FRAMEWORK

Several health behavior theories have been utilized in the development of intervention strategies for use in weight control research. One theory that has a focus on values is SDT. SDT postulates that individuals with increased self-regulation (defined as accepting the regulation for change as one's own) may have greater success in sustaining behavior change.[20, 21] Essentially, self-regulation is the way in which individuals take in social values and extrinsic contingencies and progressively integrate them into their own personal values and self-motivations.[20, 21] In the context of weight loss, it has been theorized that success is a result of individuals engaging in weight loss behaviors, such as calorie restriction, because they personally value weight loss and its health benefits and can self-regulate in accordance with those values.[21] However, to our knowledge, the use of values in predicting weight loss success or engaging in weight loss behaviors has yet to be investigated.

Several therapies have also been utilized in weight control studies that focus on values. Cognitive Behavioral Therapy (CBT) is typically utilized within standard behavioral weight loss programs to aid in adherence to weight loss prescriptions.[22-24] One strategy often utilized within CBT to aid in the initial adoption of weight loss behaviors is Motivational Interviewing. MI strategies utilize values (defined as internalized life guiding principles) as a way to understand what motivates individuals. Therefore knowing one's values may be an essential source of understanding an individual's motivation for behavior change.[19] Values exploration is used throughout the four motivational interviewing processes (engaging, focusing, evoking, planning) to guide individuals through the identification of values-behavior discrepancies to elicit personal motivation to change behavior in an effort to reduce this discrepancy.[19] The values-behavior discrepancy can be defined as the difference between the values individuals hold and how they

are living their lives in accordance with these values.[19] The underlying premise for these strategies comes from the belief that when a behavior comes in direct conflict with an individual's core values that behavior is usually the discordant behavior that changes.[25]

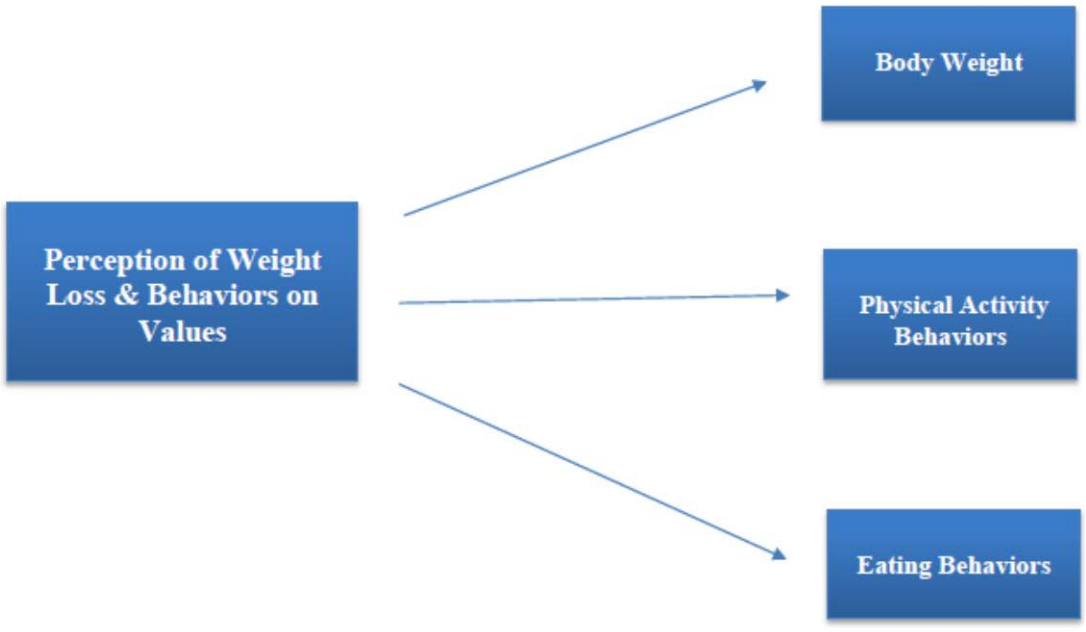
Recently, additional behavioral therapies have emerged including ACT, Dialectical Behavior Therapy (DBT), and Mindfulness-Based Cognitive Therapy (MBCT). [26] A unique feature of ACT is its focus on value systems. ACT works to increase an individual's psychological flexibility, which is defined as the "ability to stay in the present moment and to continue with one's behavior change in the midst of challenging circumstances when doing so serves the individual's deeply held values."[26] To increase one's psychological flexibility, ACT uses six core processes: acceptance, cognitive defusion, being present, values, and committed action.[26, 27] Ultimately, ACT uses mindfulness and acceptance processes to guide individuals to live a more vital, values-consistent life.[18] Therefore, the goal is that even in the presence of everyday psychological distress, individuals will persist with behavior changes because these changes will result in a life that is aligned with and directed by their values, resulting in an improved quality of life.

Several studies have examined the use of these values-based therapies for weight control such as Motivational Interviewing and the ACT model. A recent meta-analysis revealed that motivational interviewing strategies have been effective in enhancing weight loss when compared to a control group in overweight and obese individuals.[28] ACT has also been found to be successful in inducing weight loss, particularly in those individuals with greater levels of depression, disinhibition and emotional eating, and susceptibility to the food environment.[29-32] While studies are examining the use of motivational interviewing and ACT strategies in weight loss and engagement in weight loss behaviors, no studies to date have examined the values

construct of these strategies in predicting weight loss success and adherence to behaviors that lead to weight loss in standard behavioral weight loss programs.

Therefore, this project sought to examine whether those that perceive that engaging in eating behaviors, being physically active and losing weight influences their core values will have better weight loss success and engagement in weight loss behaviors. Core values were defined by the importance an individual ranks 10 domains of living such as family, marriage, parenting, social life, work, recreation, spirituality, community life, physical self-care, etc. These relationships are reflected in the following theoretical model.

Figure 1. Proposed Theoretical Framework



1.3 SPECIFIC AIMS & HYPOTHESES

The aims and hypotheses of this study include:

Aim 1: To examine if 6-month weight loss was associated with an individual's perception of how their engagement in a weight loss intervention influences domains identified as having high personal value in their life.

a. *HYPOTHESIS 1a: There would be a significant association between 6-month weight loss and the influence that engagement in a weight loss intervention has on domains identified as having high personal value in their life (measured at baseline).*
b. *HYPOTHESIS 1b: There would be a significant association between 6-month weight loss and the influence that engagement in a weight loss intervention has on domains identified as having high personal value in their life (measured at 6 months).*

Aim 2: To examine if 6-month change in energy intake was associated with an individual's perception of how their engagement in an energy restricted diet as a component of a weight loss intervention influences domains identified as having high personal value in their life.

c. *HYPOTHESIS 2a: There would be a significant association between 6-month change in energy intake and the perceived influence that engagement in an energy restricted diet as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at baseline).*
d. *HYPOTHESIS 2b: There would be a significant association between 6-month change in energy intake and the perceived influence that engagement in an energy*

restricted diet as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at 6 months).

Aim 3: To examine if 6-month change in use of strategies to modify eating behavior was associated with an individual's perception of how their engagement these strategies as a component of a weight loss intervention influences domains identified as having high personal value in their life.

e. *HYPOTHESIS 3a: There would be a significant association between 6-month use of strategies to modify eating behavior and the perceived influence that engagement in these strategies as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at baseline).*
f. *HYPOTHESIS 3b: There would be a significant association between 6-month use of strategies to modify eating behavior and the perceived influence that engagement in these strategies as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at 6 months).*

Aim 4: To examine if 6-month change in physical activity was associated with an individual's perception of how their engagement in physical activity as a component of a weight loss intervention influences domains identified as having high personal value in their life.

g. *HYPOTHESIS 4a: There would be a significant association between 6-month change in physical activity and the perceived influence that engagement in*

physical activity as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at baseline).

h. *HYPOTHESIS 4b: There would be a significant association between 6-month change in physical activity and the perceived influence that engagement in physical activity as a component of a weight loss intervention has on domains identified as having high personal value in their life (measured at 6 months).*

1.4 SIGNIFICANCE

It has been well documented that individuals entering into a behavioral weight loss program can achieve a weight loss of 10% of their initial body weight within six months; however, not all individuals achieve this level of weight loss. Because of this variability several studies have sought to examine factors that may be predictive of weight loss success. Of those studies examining these predictors, several factors have been shown to be associated with success and include greater initial weight loss,[33-36] use of self-monitoring,[37] and increases in physical activity.[12, 37] Additionally, increases in flexible cognitive restraint,[37, 38] eating, exercise, and weight management self-efficacy,[37, 39-41] self-regulation processes,[42] coping strategies,[37] internal motivation,[37] and internal locus of control[37] have also been identified. Based on this literature, it appears that psychobehavioral factors may be strong predictors of weight loss success. Furthermore, it appears that those individuals that are successful may have a stronger flexible cognition allowing them to adhere to weight loss behaviors even in the midst of challenging circumstances. A potential explanation for this persistence may be found in

unearthing one's underlying motivation for change which could be rooted in an individual's core value system. However, these relationships have not been examined.

Therefore, this study aimed to discover whether individuals who live a more values-consistent life may be more likely to adhere to treatment in the short-term, resulting in greater adherence to the behaviors that lead to weight loss. It also sought to examine these constructs within the first 6 months of a standard behavioral weight loss program because it has been shown that early, successful weight loss is predictive of long-term success.[35] Thus, the current study may allow further identification of these predictors of success, as well as characterization of individuals who are more likely to be successful, and those who may need more intensive or individualized treatment. In addition, if it is found that values play a substantial role in weight loss behaviors, interventions may be strategically adapted to highlight and address these constructs early in the intervention to potentially improve short-term success.

2.0 REVIEW OF THE LITERATURE

Obesity is defined as abnormal or excessive fat accumulation that leads to a poor health profile.[2] Currently, obesity is a global and national public health epidemic. To determine overweight and obesity status among adults, an index of weight-to-height termed body mass index (BMI) is often utilized. BMI is defined as an individual's weight in kilograms divided by height squared in meters (kg/m^2). An individual is classified as overweight with a BMI of ≥ 25 kg/m^2 and obese with a BMI of $\geq 30 kg/m^2$.[1-3] Globally, more than 1.4 billion adults aged 20 years and older are classified as overweight and 500 million as obese.[1] The United States has one of the highest rates of overweight and obesity with adults over 20 years of age having a prevalence of overweight and obesity that is approximately 68.5% and 34.9%, respectively.[5]

Obesity leads to an increase in morbidity and mortality [1, 2, 43-45] and has been shown to contribute to the development of several clinical diseases such as cardiovascular disease, diabetes, and various cancers. It has been estimated to account for 44% of the burden for diabetes, 23% of the burden for ischemic heart disease, and 7-41% of the burden for several cancers. [1, 2, 44, 46, 47] It has also been shown to increase one's risk for stroke, obstructive sleep apnea, asthma, and non-alcoholic fatty liver disease.[2, 43, 47] Beyond the link to clinical disease and increased mortality, obesity has also been shown to reduce quality of life, physical functioning, and fertility, as well as an increased risk of depression, anxiety and issues of weight

stigma.[2, 44, 48, 49] As obesity has been linked to several co-morbidities listed above, the economic burden of obesity is also substantial.

The economic impact associated with obesity has been detailed in both direct and indirect costs. Direct costs are defined as medical expenditures and indirect costs include work absenteeism, productivity losses due to illness, decreased years of disability-free life, and early retirement.[50] Worldwide, it has been shown that obesity results in an increase of a country's healthcare costs by approximately 0.7-2.8% annually. [51] The most recent nationwide analysis on the estimated direct costs of obesity revealed there is an increase of $3,508 per year per individual and $315.8 billion total for the United States.[7] Furthermore, it has been estimated that healthcare costs may increase by 28 billion dollars a year by 2020 and 66 billion dollars a year by 2030 if obesity rates continue to rise based on recent projection models.[50] Indirect costs described as productivity losses due to absenteeism and presenteeism have also been estimated for the United States. For men, annual missed workdays ranged from 0.5 more days in overweight men to 5.9 more days in men with severe obesity, and the value of work lost ranged from 2.3 days to 21.9 days with varying obesity categories.[52] In women, absenteeism was also greater with increases in BMI and value of work lost ranged from 6.3 days to 22.7 days.[52] Additionally, it has been estimated that a continuing trend in obesity would result in a loss of quality-adjusted life-years in the amount of 2.2-6.3 million from 2010-2030.[50] Clearly the economic burden of overweight and obesity goes well beyond the direct medical expenditures related to this disease and its' co-morbidities.

Due to the health complications and increased economic burden related to obesity, it has become a national priority to reduce the rates of obesity and promote healthy weight maintenance. One strategy to do this is through improvements in diet and physical activity.

Specifically, Healthy People 2020 set goals to “improve health, fitness and quality of life through daily physical activity” and “promote health and reduce chronic disease risk”.[8] Their recommendations to accomplish these goals include: (a)reduce the proportion of individuals who engage in leisure time sedentary behaviors, (b)increase the proportion of individuals who meet the national recommendations for aerobic and strength training modalities, (C)increase the proportion of individuals that consume a healthful diet, and (d)increase the proportion of individuals that achieve and maintain a healthy body weight.[8] Therefore, it is of national importance to identify treatments that will aid individuals in weight loss and weight loss maintenance. These treatments, if effective, may result in an overall population reduction of overweight and obesity rates, clinical disease caused by obesity, and direct and indirect costs related to obesity.

2.1 TREATMENT OF OBESITY

Currently, there are several treatments available for individuals seeking to lose weight and reduce their risk of mortality and morbidity related to obesity. These treatments include bariatric surgery, pharmacotherapy, and lifestyle behavior change programs.[3] The goal of these treatments is to produce a weight loss of at least 5-10% within the first 6 months of treatment, as this has been shown to provide significant health benefits. Specifically, this level of weight loss has been shown to reduce triglycerides, blood glucose, HbA1C, risk of developing type 2 diabetes, blood pressure, and improve low density lipoprotein C and high density lipoprotein C.[3]

The decision as to which treatment would be the best for each individual is largely dependent on the individual's BMI status and risk factor profile. Bariatric surgery is currently recommended in individuals with a BMI $\geq$ 40kg/m^2 or a BMI >35kg/m^2 with co-morbidities and who have not responded to behavioral treatment with or without the use of pharmacotherapy.[3] Pharmacotherapy is currently recommended in individuals with a BMI $\geq$ 30kg/m^2 or BMI $\geq$ 27kg/m^2 with comorbidities as a supplement to standard lifestyle interventions.[3] Standard lifestyle behavioral interventions are recommended for individuals with a BMI $\geq$ 25kg/m^2 and are recommended to be used in conjugation with bariatric surgery and pharmacotherapy.[3] Because standard lifestyle behavior change interventions are recommended at all levels of overweight and obesity, it is apparent that standard lifestyle behavior change interventions are the foundation of weight management strategies. These interventions seek to induce weight loss through a combination of energy restricted diets, increased physical activity and behavior change strategies which typically result in a mean weight loss of 8kg (17.6lbs) or 5-10% of an individual's initial weight within the first 6 months of treatment.[3, 13] Although this is defined as successful weight loss, [3, 10, 12, 23] continued improvement is warranted in terms of amount of initial weight loss and sustainability of weight lost.

At a very basic level, the management of body weight is dependent on energy balance. The energy balance equation simply states that weight change is a result of the difference between energy in and energy out, and includes the energy consumed through food and drink and the energy expended, which encompasses the thermic effect of food, resting energy expenditure, and physical activity.[53] In order for an individual to successfully lose weight, the energy they expend would need to exceed the energy they consume, thereby tipping the energy balance equation in the negative direction. In order to aid individuals in this process, intervention and

behavioral strategies focus on reducing caloric intake and increasing physical activity. According to the 2013 American Heart Association (AHA), American College of Cardiology (ACC) and the Obesity Society (TOS) Obesity 3 Guidelines, the current recommendations seek to reduce caloric intake by either 500-1000 kcals per day or a 30% reduction in current caloric intake in order to elicit a weight loss response of 0.5-0.9kg (1-2 lbs) per week.[3, 9-11, 23] Strategies focusing on reducing the consumption of specific food types such as high-carbohydrate foods, low-fiber foods, or high-fat foods have also been recommended.[3, 11, 23] The evidence suggests that the specific food type chosen to aid in caloric deficit is largely dependent on the preference of the individual, their health status, and their ability to sustain these changes long-term.[3, 23]

In order to increase the amount of energy expended the focus of the physical activity recommendations includes aerobic physical activity progressing from 150-300 minutes per week (30-60minutes per day 5 days per week) or achievement of an equivalent energy expenditure of ~ 1200 to 2000 kcal/wk. [3, 9, 12, 23] This level of exercise has been shown to aid in the reduction of weight, as well as promote long-term weight loss maintenance and prevention of weight regain.[3, 12, 23]

Finally, in order to aid individuals in adhering to the eating and exercise recommendations necessary to induce and maintain weight loss, the use of behavioral strategies is recommended. The behavioral components include, but are not limited to: problem solving, social support, goal setting, motivation, stimulus control, relapse prevention, cognitive restructuring, and self-monitoring of food and beverage intake, portion sizes of food and beverage intake, calories, fat grams, physical activity, and weight.[3, 9, 23, 54]

While standard lifestyle programs have been shown to be successful in producing weight losses that result in significant reduction in risk factors for several clinical diseases, there is still

considerable variability in the amount of weight lost per individual. A recent meta-analysis of standard lifestyle programs illustrated this variability in both intense (intervention that required session attendance in average amount of 37 hours) and less intense interventions (interventions that required session attendance in the average amount of 5 hours). Specifically, of those individuals that participated in intensive programs, 28% lost ≥ 10% of initial weight, 26% lost 5-9.9%, and 38% lost 0.1-4.9%.[14] This was further illustrated in less intensive programs revealing 13% of participants lost ≥ 10% of initial body weight, 16% lost 5-9.9%, and 27% lost 0.1-4.9%.[14] Due to this variability in weight lost, it has been recommended that future research should aim to evaluate characteristics of those who lose less weight in response to a standard lifestyle program (sometimes called "nonresponders") compared to those who do lose the predicted amount or more (sometimes called "responders") so that we may develop better treatment options for everyone.[3]

Considering obesity has been described as a chronic condition, understanding the relationship between biological, environmental, and behavioral influences is important to understanding why some individuals respond to treatment and others do not.[15] Specifically, research identifying the underlying characteristics and processes utilized by responders versus nonresponders is warranted. There have been previous studies attempting to predict who will be successful based on individual characteristics and psychosocial factors, and some of this literature will be reviewed in the following section.

2.2 PSYCHOBEHAVIORAL PREDICTORS OF WEIGHT LOSS

A key to success in lifestyle interventions is adherence to weight loss behaviors such as meeting diet and physical activity prescriptions, attending group sessions, and using self-monitoring tools.[15, 55] One potential explanation for the variability in weight loss success is that for some individuals the perceived cost to adhere to these key behaviors begins to outweigh the perceived benefits, resulting in a reduction in adherence to the weight loss prescription over time.[15] However, research has shown that some individuals are able to adhere to these behaviors even in the presence of multiple barriers. For example, Gallagher, et al. revealed that individuals participating in a behavioral intervention who achieved ≥10% of weight loss and ≥300 min/wk of moderate-vigorous intensity physical activity actually reported more obstacle barriers to meeting those recommendations compared to those who only reached 150-199 min/wk of physical activity.[16] The authors explained that even though this group of individuals experienced barriers, they were able to overcome them, and these associations and types of individuals deserve further investigation.[16]

Beyond adherence to weight loss prescriptions it is important to examine other factors that may be predictive of weight loss. Examining these factors will aid in the identification of those individuals that are more likely or less likely to respond to treatment early and thus provide better individual outcomes. Of those studies examining these predictors, several factors have been shown to be associated with success including greater initial weight loss,[33-36] use of self-monitoring,[37] and increases in physical activity.[12, 37] Additional psychosocial factors, such as increases in flexible cognitive restraint,[37, 38] eating, exercise, and weight management self-efficacy,[37, 39-41] body attractiveness,[38] physical self-worth,[38] social support,[37] self-regulation processes,[42] coping strategies,[37] internal motivation,[37] and internal locus of control,[37] have

also been identified. Furthermore, reductions in emotional eating responses,[38] as well as decreased concerns with body shape and size dissatisfaction,[38] were shown to improve success. Based on this literature, it appears that psychobehavioral factors can be strong predictors of improved weight loss. Therefore, understanding the relationship between psychobehavioral factors, engagement in weight loss behaviors, and subsequent weight loss warrants further investigation.

Of particular interest to this project are those factors that relate to the mental and emotional environment of the individual, such as one's psychological flexibility, internal values, and underlying motivations. One related eating factor that has been well researched is termed disinhibition, as measured by the Eating Inventory, which assesses eating in response to emotional, cognitive, or social cues.[56] Niemeier et al. examined whether factors identified on the disinhibition scale of the Eating Inventory related to weight loss in overweight men and women participating in a behavioral weight loss program. The behavioral weight loss treatment included two physical activity groups divided on energy expenditure (low: 1000kcal/wk energy expenditure through exercise; and high: 2500kcal/wk energy expenditure through exercise). Participants met weekly for 6 months, biweekly for 6 months, and monthly for the remaining 6 months. The study results revealed that individuals with high levels of internal disinhibition to eating (eating in response to thoughts and feelings) were less likely to lose weight over time.[57]

Additionally, Teixeira et al. examined mediators of weight loss in previously overweight or obese women who participated in a 12-month behavioral weight loss treatment program. Participants were pre-menopausal overweight or obese women between 25-50 years of age, and they were randomly assigned to either a 1-year behavioral intervention or a 1-year general health education control group. The behavioral intervention included information on increasing

physical activity and energy expenditure, adopting a moderate energy deficit diet (decreased daily caloric intake by 300-400kcal), identifying personal resistances, overcoming lapses, establishing adequate goals, and utilizing self-monitoring tools.[38] The results revealed that lower emotional eating, increased flexible cognitive restraint (low emotional or disinhibited eating), and fewer exercise barriers mediated 12 month weight loss.[38]

Therefore, an individual's internal environment may significantly influence their ability to successfully self-regulate and engage in weight loss behaviors in order to lose weight. An individual's ability to improve this regulation may be due to maintaining a flexible cognition that lowers psychological distress and ultimately perceived barriers to engagement in behavior changes. Overall, the literature suggests that individuals with an increased ability to overcome emotional eating and perceived barriers through psychological flexibility may be more likely to succeed in behavioral weight loss programs, but further exploration of why some individuals have greater flexible control over eating and exercise behaviors compared to others is needed.

In addition to understanding barriers and cognitive styles, understanding what motivates an individual to adhere to weight loss prescriptions is crucial.[15] Exploring psychological determinants of health behaviors also remains an important research question, particularly distinguishing the reasons, goals, expectations, values, beliefs, or self-perceptions of those that do or do not engage in health behaviors.[17] Specifically, an individual's values may be one of those concepts that should be examined when determining what underlies motivation and adherence. One's values are often referred to and focused on within behavioral counseling sessions, but as of yet these strategies are not well defined and the recommendations on how to use them are vague. Not much is known about the role of values in engagement in diet and

exercise prescriptions, and therefore gaining an understanding of the role of these motivational constructs to the adherence of weight loss behaviors is warranted.[15]

Furthermore, it is important to understand the relationship between values, psychological distress, and engagement in weight loss behaviors. Research has shown that there are some individuals that adhere to weight loss behaviors even in the presence of physiological distress. A potential explanation for their ability to do this could be that their underlying motivation is related to living a more rewarding life within a core value system and because of this they continue with behavior change in the midst of challenging circumstances. The perceived cost to benefit ratio is perhaps reversed in these individual's such that the benefits of engaging in weight loss behaviors outweighs the cost because their motivation to engage is rooted in their core value system. However, these theoretical relationships need to be examined in experimental trials such as behavioral weight loss interventions. In fact, this is a goal of some behavioral theories and therapies that have emerged and are detailed below.

2.3 BEHAVIORAL THERAPY

Currently, comprehensive lifestyle weight loss programs that utilize behavior change strategies are rooted in CBT.[22, 23] Theses behavioral modification strategies utilize techniques, such as: goal setting, self-monitoring, stimulus control, changing the environment, problem solving, and relapse prevention.[22] The cognitive modification strategies utilized in weight loss interventions include: assessing and increasing motivational readiness to change, understanding patient's expectations for treatment and the rationale behind these expectations, how expectations evolve over time, as well as the cognitive restructuring of negative self-perceptions

related to diet, exercise, and weight loss.[22] The specific focus on values within behavioral theories and therapies is found primarily in SDT, MI, and ACT.[18-20]

2.3.1 Self-Determination Theory & Values

SDT is an approach to understanding and explaining human motivation and personality that investigates individual's innate growth tendencies and psychological needs as a basis for self-motivation.[20] Essentially, SDT suggests there are three empirical need processes: the need for competence, relatedness, and autonomy.[20] These needs are theorized to be essential for optimal functioning, growth and integration, social development, and personal well-being. SDT also examines how social environments affect positive developmental tendencies.[20] Specifically, SDT examines self-regulation, which elicits how individuals take in social values and contingencies and transform them into personal values and self-motivation.[20] At a basic level, SDT examines the nature of an individual's motivation for behavior change and seeks to understand whether individuals affirm a behavior out of interest, value, or reasons external to them. [20]

When considering SDT within the context of weight loss, it has been suggested that successful behavior change depends on accepting the regulation for change as one's own rather than just complying with demands for change.[21] In terms of values, this implies that positive behavior change requires internalizing values and regulating relevant behaviors in accordance with those, so that these values may be integrated into one's sense of self.[21] For example, it has been theorized that successful weight loss due to individuals engaging in the required eating behaviors may result because the individual values both weight loss and the health benefits associated with it.[21] However, the relationship between values, engagement in weight loss

behaviors, and subsequent weight loss have not been examined specifically. Furthermore, examining whether individuals fully integrate engagement in these weight loss behaviors into their value system warrants further investigation.

2.3.2 Motivational Interviewing & Values

Motivational Interviewing (MI) is a collaborative, goal-oriented style of communication with particular attention to the language of change. It is designed to strengthen personal motivation for and commitment to a specific goal by eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion.[19] In order to accomplish this goal, MI uses four core: processes- engaging, focusing, evoking, and planning. [19] Engaging is defined as a process by which both the participant and the interventionist establish a helpful connection and working relationship. Focusing is defined as a process by which one develops and maintains a specific direction in the conversation about change. Evoking is eliciting the client's own motivation for change and is done when the focus on a particular change has been established. An interventionist utilizing MI would draw out the participants' own ideas and feelings about how and why they might make the particular change. This process is at the heart of MI. Last, planning is initiated when the participants motivation reaches the point of readiness to change and steps are taken to implement when and how the change will occur.[19]

Values exploration is a core component of MI and is used within the focusing, evoking, and planning processes.[19] MI strategies suggest that understanding an individual's broader life goals or core values is the key to understanding what motivates an individual and another way in which to promote engagement in new behaviors.[19] One specific strategy within MI that is used to elicit values-behavior discrepancy awareness within the participant is called the Q

technique.[19] The Q technique is a set of 36 value cards that are thought to guide behavior, 18 instrumental (pleasure, an enjoyable, leisurely life) and 18 terminal (helpful, working for the welfare of others). The cards are shuffled and individuals are asked to rank order each set of 18 values from lowest to highest priority.[19] Using this technique an interventionist can explore an individual's top 5 to 10 values in order to develop an understanding of what matters and motivates an individual and the standards that guide their life. It has been suggested that this exercise can cause individuals to reflect on discrepancies between what they value and how they are living in accordance with those values.[19] These perceived value-behavior discrepancies may trigger behavior change as it has been shown that when a behavior comes into direct conflict with an individual's core value system, it is usually the behavior that changes.[19]

Although an MI Values intervention has not been conducted in adult populations, it was implemented in overweight and obese adolescents as an adjunct therapy to a multidisciplinary treatment that included physical activity, dietary intervention, and behavioral support.[58] Participants were randomized to either an MI values multidisciplinary treatment or education control multidisciplinary treatment.[58] The participants in the MI treatment group completed two, 30 minute sessions of MI values at week 1 and week 10 of the 6 month intervention. Session 1 of the MI values intervention included a values clarification exercise in which participant's selected their top five values and were instructed to explore the relation of these values to their target behavior. Participants also worked with clinicians to identify discrepancy between values and current behaviors in order to increase readiness to change.[58] Session 2 of the MI values intervention included exploration of the participant's progress with the multidisciplinary treatment goals, re-examined value/behavior congruency, and participants own ideas for behavior change.[58] The control group viewed two, 30 minute health education

videos.[58] The primary outcome was examining whether the MI values intervention resulted in increased adherence to the multidisciplinary treatment.[58] When compared with controls, the MI values group had increased adherence at 3 and 6 months.[58] The authors plan to also examine the effects of MI on diet, physical activity, and BMI percentiles; however, data has not yet been published.[58] The use of MI strategies has also been shown to be effective in enhancing weight loss in overweight and obese adults when compared to control groups; however, the examination of the specific values-behavior relationship has not been done and warrants further investigation.[28]

2.3.3 Acceptance and Commitment Based Therapy (ACT) & Values

While SDT and MI have aspects that focus on values, ACT is a more recent therapy where values exploration is at the heart of its model. ACT is grounded in Relational Frame Theory which suggests that at the core of human language and cognition is the ability to: (1) relate events mutually and in combination with arbitrary cues, and (2) to change the function of various events based on their relation to others.[18, 26] Essentially, the Relational Frame Theory focuses on "relational frames" that are broken down into two features, the relational context and the functional context. The relational context determines how and when events are related (what an individual will think) and the functional context determines what functions will be transformed from a relational network (the psychological impact of what you think).[18] At the core of ACT therapy is guiding individuals to have an increased psychological flexibility, which is defined as "being able to contact the present moment as a conscious human being more fully as it is, not as what it says it is, and based on what the situation affords, persisting or changing in behavior in the service of chosen values".[18] Ultimately, ACT therapy works with individuals to

persist in desired behavior changes even in the face of perceived barriers because doing so will allow them to live more consistently with their core values, hopefully resulting in a more meaningful life. In order for this to be accomplished, ACT utilizes six core processes, of which values is one.

The six processes utilized in the ACT model to increase physiological flexibility include acceptance, cognitive defusion, being present, self as context, values, and committed action.[18] These processes are defined as follows: (A) Acceptance – the active and aware embrace of those private events occasioned by one's history without unnecessary attempts to change their frequency or form, especially when doing so would cause psychological harm; (B) Cognitive Defusion – changing the way one interacts with or relates to thoughts by creating contexts in which their unhelpful functions are diminished; (C) Being Present – ongoing, non-judgmental contact with psychological and environmental events as they occur or experiencing the world more directly so behavior is more flexible and consistent with core values; (D) Self as Context – individuals become aware of one's own flow of experiences without attachment to them or an investment in which particular experiences occur; (E) Values – chosen qualities of purposive action that can never be obtained as an object but can be instantiated moment by moment; and (F) Committed Action – development of larger patterns of effective action linked to chosen values.[26]

The ultimate goal of ACT is to guide individuals to live a more values-consistent life by increasing their ability to engage in behaviors that service or enhance their ability to live more consistently with their chosen values.[18] The ACT model define values as "freely chosen, verbally constructed consequences of ongoing, dynamic, evolving patterns of activity, which establish predominant reinforcers for activity that are intrinsic in engagement in the valued

behavioral pattern itself".[27] In essence, the values construct in ACT guides individuals to plan or prioritize their time and activities with those things that are meaningful to them in life, otherwise termed "valued pattern of living".[27, 59] To facilitate this, the six processes of ACT are grouped together into two broader groupings: (1) mindfulness and acceptance, and (2) commitment and behavior change.[26] The mindfulness and acceptance processes are meant to clear a psychological path for individuals to live a more vital values-consistent life.[18] The commitment and behavior change processes are more closely linked to cognitive-behavioral therapy in that they use goal setting and skills acquisition to develop behaviors or actions that are consistent with stated values.[26] In essence, values make all other processes meaningful.[18, 26] Therefore, in the presence of stressful life events, individuals will persist and be more successful with behavior changes because these changes will result in a life that is aligned and directed by their values.

Values assessment in ACT is often performed so with the Valued-Living Questionnaire-II (VLQ-II),[27] which examines both the importance and commitment processes in valued living. The importance processes examine the extent to which individuals hold particular domains as values. It also determines the level of activity within those domains, and seeks to understand the obstructions to valued living in these various domains. The commitment processes then examine specific engagement in each valued domain. Essentially, the values processes determine a valued pattern of living and the commitment processes determine behaviors and actions that allow an individual to live consistently with that valued pattern of living. ACT research has begun to specifically examine the role of values in areas such as chronic pain and refractory epilepsy and have shown improved life functioning for those with chronic pain and reductions in the frequency of seizures for those with epilepsy.[60]

In terms of weight control, it has been suggested that ACT constructs may aid individuals in the adoption of healthy behaviors that are consistent with an individual's stated values. That is, while weight loss itself may not be a prioritized value, the behaviors that lead to weight loss may be valued actions.[24] For example, an individual might engage in dietary and physical activity prescriptions to lose weight because this may allow them to live longer in order to participate in valued relationships, be a role model for family and friends, or be more productive or successful at work. Therefore, if individuals can find the meaning behind the behaviors required to lose weight they may be more likely to adhere to weight loss prescriptions. This may result in successful weight loss in the short-term, even in the presence of challenging circumstances.[24] Several studies have begun to examine the ACT model in several domains of weight control in order to establish if these relationships exist and some of these will be highlighted in the following section.

2.3.4 ACT Interventions

Although the ACT paradigm and constructs are relatively new, the use of the ACT model in weight control studies has been shown to be successful in inducing weight loss particularly in individuals that have greater levels of depression, disinhibition and emotional eating, and susceptibility to the food environment.[29-32] For example, Forman et al. examined a non-controlled trial utilizing ACT therapy intervention that specifically focused on distress tolerance, mindfulness, and commitment enhancement in overweight and obese women over a 12 week period.[61] The results indicated that the acceptance-based strategies improved participants' abilities to adhere to the behaviors that induce weight loss.[61] Furthermore, participants who completed the intervention lost 6.6% of their body weight from baseline to post-intervention and

continued to lose weight (9.6%) over the 6 month follow-up period,[61] which is consistent with what standard behavioral interventions can produce.

Another study focused on obesity stigma and weight control efforts through the use of a 1 day ACT workshop versus a wait list control. Participants were individuals who had completed at least 6 months of any structured weight loss program in the past 2 years.[30] The focus of the protocol was to guide participants and instruct them on skills to "live a more fulfilling life consistent with their chosen values" and increase their psychological flexibility.[30] After a 3 month follow-up period, results revealed that those participants in the ACT group had greater reductions in BMI and had more favorable distribution of weight changes (plus or minus 5 lbs) compared to those in the control group. Specifically, 35% of those in the ACT condition lost 5 lbs or more, whereas only 11% in the control condition did. Additionally, only 7% of those in the ACT condition gained 5 lbs in the follow-up period, whereas 25% of those in the control condition did. The participants in the ACT condition had greater overall levels of acceptance, defusion, and action, as well as greater weight-related acceptance, defusion, and action even in the face of barriers. They also had greater levels of objective distress tolerance as determined by a breathe holding measure.[30] It was found that weight-specific ACT processes as measured by the Acceptance and Action Questionnaire for Weight-Related Difficulties (AAQW)[62] significantly mediated all outcomes, whereas changes in general ACT processes mediated changes in psychological distress, quality of life, and stigma, but not BMI.[30] The authors suggest that the mediational impact of these processes may be a mechanism by which individuals are more successful with weight control and warrants further investigation.[30]

While the studies listed above have examined ACT vs. a control condition, a more recent study has examined ACT vs. standard behavioral therapy in inducing weight loss.[29] Overweight

or obese adults were randomly assigned (blocked by baseline BMI) to either a standard behavioral intervention or an acceptance based intervention.[29] Participants were involved in 30, 75 minute group-based sessions over a 40 week period and then were followed for 6 months post-intervention.[29] Results revealed that when treatment was administered by experts (clinical psychologists with experience administering behavioral weight control interventions), participants in the ACT group had significantly higher weight loss post- intervention and at 6 month follow-up compared to the standard behavioral treatment (SBT) participants.[29] ACT participants lost 13.17% of weight at post-treatment compared to 7.54% of those in the SBT, and maintained a 10.98% weight loss at the 6-month follow-up compared to 4.83% for the SBT group.[29] Furthermore, participants who were more susceptible to eating cues (e.g. availability of highly palatable food), had greater baseline depression, emotional eating, and disinhibition showed improved weight loss success when receiving the ACT intervention compared to the standard behavioral intervention.[29]

Given the results of the above study, Niemeier et al. examined the use of acceptance-based strategies within a behavioral weight loss intervention in those individuals that reported high levels of internal disinhibition at baseline.[32] Overweight or obese adults who had high scores (scored a five or greater) on the Internal Disinhibition subscale of the Eating Inventory participated in the study.[32] The intervention required participants to meet weekly for the first 6 months after which participants completed a 3 month follow-up no-treatment contact period.[32] At 6 months participants lost an average of 12.0kg (26.4lbs) and maintained that weight loss at the 3 month follow-up.[32] At both time points there were significant decreases in internal and external disinhibition as well as significant decreases in difficult weight-related thoughts, feelings, and actions (termed experiential avoidance). Psychological inflexibility also decreased

from baseline to 6 months, and this change was maintained at the 3 month follow-up.[32] Therefore, it appears that ACT is effective in inducing weight loss in overweight and obese adults and in some cases to a greater extent than standard behavioral interventions. This is particularly true for those individuals with greater psychological barriers to success. However, work in this area is preliminary and further research is needed to better understand the relationship between ACT process measures, such as values, and engagement in weight loss behaviors that subsequently lead to weight loss.

ACT strategies and constructs have also been applied to helping individuals change their susceptibility to the food environment, especially in the context of food cravings, which can be a barrier to weight loss. To better understand the relationship of treatment condition, coping strategies, and values when dealing with food cravings, one study examined the role of acceptance-based strategies vs. standard coping strategies in overweight women.[63] In this study, overweight women were randomized to either a cognitive-based coping strategy group or an acceptance-based coping strategy group. Participants in the cognitive-based coping strategy group received instruction on how to restructure maladaptive indulgence thoughts and use techniques such as positive imagery and mind games to distract themselves from cravings. Participants in the acceptance-based coping strategy group were taught that cravings are normal and expected, outside of their voluntary control and should be accepted as they are. They were then taught defusion techniques in which they were encouraged to experience cravings without actually eating the desired food which would result in an unpleasant experience. The final component of the acceptance-based coping strategy group was instructing the participants that these principles facilitate committed action to keep in accordance with goals and values rather than manage unpleasant internal experiences.[63] After receiving instruction on how to cope with

food cravings based on their randomized assignment, participants were instructed to carry a package of sweets with them for 72 hours while also refraining from consuming any foods that contained added or artificial sugars.[63] The results revealed that the acceptance-based group had reduced cravings and consumption of sweets, particularly in those individuals that had higher levels of susceptibility to the food environment and emotional eating when compared to the standard group.[63] Therefore, it appears that acceptance-based strategies may be effective in reducing or controlling food cravings in overweight individuals, particularly in those individuals that are highly susceptible to the food environment and emotional eating.

Based on the limited literature, it appears that the use of ACT interventions and values constructs within them can be successful in producing significant weight loss, particularly in those individual's that have higher levels of internal disinhibition and depression. Furthermore, ACT strategies may be helpful in reducing barriers to adherence to eating behaviors by reducing an individual's susceptibility to the food environment. It also appears that process variables such as psychological flexibility and experiential avoidance are mediating the relationship between changes in these variables and weight; however, no studies to date have examined whether changes in the process measure of valued living plays a role in adherence to dietary and exercise prescriptions, and subsequent weight loss. Given that valued living is at the core of ACT therapy, this process measure is of particular importance to investigate in weight control studies. While there is some empirical support for the values processes there is a need to understand the role of values in predicting outcomes.[60] Furthermore, no studies have examined value processes in predicting engagement to dietary and physical activity prescriptions and subsequent weight loss in weight control interventions.

2.4 CONCLUSION

Based on the literature, it is apparent that obesity is a major public health concern that needs to be addressed in order to improve the health of our nation. Current obesity treatments can be effective in reducing weight and improving health in individuals that seek treatment; however, there is considerable variability in the amount of weight each individual loses and not everyone responds equally well. A key component in the treatment of obesity is the use of behavioral strategies to improve adherence of weight loss prescriptions. SDT, MI, and ACT all suggest that an individual's value system is an important concept to investigate in order to understand an individual's motivation to change. Furthermore, focusing on values and guiding individuals to integrate their behavior changes into their value system may lead to a stronger motivation for change and greater success. However, little attention has been paid to the values construct of these theories and therapies.

Therefore, this project sought to gain a better understanding of this construct in a standard behavioral weight control intervention. Specifically, the proposed project sought to identify the primary values of individuals enrolled in a standard behavioral weight loss intervention and examine if these values changed over the course of an intervention. In addition, it aimed to evaluate whether individuals who perceive that engaging in eating and physical activity behaviors that induce weight loss and improve health align with their values will have improved weight loss success. If it is found that values play a significant role in weight loss behaviors, interventions may be strategically adapted to highlight and address these constructs early in the intervention to potentially improve short-term weight loss success.

3.0 METHODS

The current project is an ancillary study to a parent study. The parent study is an ongoing randomized clinical trial to predominantly assess changes in left ventricular mass by cardiac MRI in response to a 12-month standard behavioral weight loss intervention that varies by physical activity prescriptions. The ancillary study only used data from the first 6 months of the intervention. The intervention is modeled after well-established theoretical models for lifestyle behavior change and previous successful interventions conducted by the principle investigator of the parent study. Below is a summary of the current study's methods and procedures, which have been selected from the parent study's procedures and as such are unable to be modified for this project.

3.1 RECURITMENT AND SCREENING PROCEDURES

The parent study utilized postcard mailings, newspapers, and radio advertisements to recruit subjects. In addition, letters were mailed to eligible individuals from the Obesity and Nutrition Research Center Clinical Registry. Individuals who were interested in participating were instructed to call the Physical Activity and Weight Management Research Center (PAWMRC) at the University of Pittsburgh to be screened for eligibility. Trained research staff provided a description of the study to interested participants and upon receiving verbal consent,

followed the phone screening procedures to determine initial eligibility. The phone screen included questions about demographic characteristics, medical history, and general physical health. Those participants who were found to be initially eligible based on the phone screen were asked to provide contact information and were invited to an orientation session conducted by the Principal Investigator of the parent study. The orientation session provided a detailed study description to potential participants, and informed consent was obtained before further participation. All study procedures were approved by the Institutional Review Board at the University of Pittsburgh.

3.2 INCLUSION AND EXCLUSION CRITERIA

The parent study recruited 383 apparently healthy men and women between the ages of 18-55. The recruitment for the parent study had already been in progress and at the time of this project there were only approximately 75 participants left to recruit. This sub-sample of the parent study was utilized for the ancillary study.

Inclusion criteria included: (1) participants who are either overweight, Class 1, or Class II obese (according to the BMI classification of 25.0-39.9 kg/m^2) and (2) sedentary defined as <60 minutes per week of moderate-intensity exercise over the past 3 months. Exclusionary criterion for the parent study is detailed below:

1. Diagnoses of heart disease, angina, uncontrolled arrhythmia, or previous cardiovascular event, coronary artery bypass grafting, or angioplasty.
2. Resting systolic blood pressure ≥160 mmHg or resting diastolic blood pressure ≥100 mmHg or currently taking hypertension medications, as hypertensive

individuals planning to engage in vigorous activity should be medically supervised.[64]

3. Conditions affecting heart rate, blood pressure, or metabolism due to diabetes, thyroid, cancer (current treatment or within the past 5 years), chronic renal insufficiency or chronic liver disease.
4. Current diagnosis or treatment for psychological disorders, or taking psychotropic medications that could impact body weight or interfere with the intervention and outcome measures.
5. Current treatment of an eating disorder.
6. Women who are pregnant, breastfeeding, or have been pregnant in the previous 6 months.
7. Current participation in a weight loss program, ≥5% weight loss within the past 3 months or taking medications for weight reduction which would confound the parent study intervention and outcome measures.
8. Any physical limitation that would impact an individual's ability to walk for exercise, which is a component of some of the intervention arms.

3.3 INTERVENTION DETAILS

The current ancillary study did not assess or analyze any outcomes by randomized group assignment; such comparisons will occur upon completion of the parent study. The parent study is a 12-month behavioral intervention; however, the ancillary study only analyzed data from baseline and 6 months. Therefore, a brief description of the intervention arms and the

intervention procedures is only provided for the first 6 month of the behavioral intervention. This information is provided below for the purpose of providing an overview of the parent study and thus cannot be modified.

DIET ONLY: Participants received intervention with an energy intake prescription of 1200-1800 kilocalories per day (kcal/d) and 20-30% dietary fat intake based on initial body weight. A physical activity prescription was not provided to this group.

DIET + MODERATE PHYSICAL ACTIVITY: Participants received intervention with an energy intake prescription identical to the DIET group. In addition, participants were prescribed 150 minutes per week of moderate intensity exercise (55-70% of age predicted maximal heart rate), which progressed in a gradual manner.

DIET + HIGH PHYSICAL ACTIVITY: Participants received intervention with an energy intake prescription identical to the DIET group. In addition, participants in this study arm were prescribed an exercise prescription of 250 minutes per week of moderate intensity exercise (55-70% of age predicted maximal heart rate), which progressed in a gradual manner.

Months 1-6: Participants in all groups reported weekly to the PAWMRC for a one-hour group session where staff members delivered information according to the randomized group assignment within the behavioral weight loss intervention, which may have included nutrition, exercise, and other lifestyle factors. Body weight was tracked and paper self-monitoring diaries (reporting foods, calories, fat gram, and exercise if applicable) were turned in weekly to intervention staff for review and feedback.

3.4 DESCRIPTION OF ASSESSMENTS

Participants reported to the PAWMRC for 2 assessment visits at 0 and 6 months. All described assessment measures for this project were performed at both time points. Prior to arrival, assessment instructions to participants included: a) no food or beverage (with the exception of water) for 12 hours prior, b) no alcoholic beverages 24 hours prior, c) no vigorous activity 24 hours prior, d) no smoking 24 hours prior, and e) lightweight comfortable clothing and shoes for walking on a treadmill. The first five measures are a part of the parent study data collection protocol and were utilized as a part of this ancillary study for outcome data. The Valued Living Questionnaire and Perception of Weight and Behaviors on Values Questionnaire are additional questionnaires that were added to the parent study for the purpose of this ancillary study.

3.4.1 Body Height, Weight, and Body Mass Index

Height was measured using a wall-mounted stadiometer (Perspective Enterprises; Portage, MI) to the nearest 0.1 cm. Participants were dressed in a hospital gown and asked to remove shoes prior to measurement. Two height measurements were taken and, if there was a $\geq$ 0.5cm difference, a third measure was taken. Body weight was measured to the nearest 0.l kg using a digital scale (Tanita Corporation; Arlington Height, IL). Two weight measurements were taken and, if there was a $\geq$ 0.2 kg difference, a third measurement was taken. BMI was calculated as kg/m^2.

3.4.2 Paffenbarger Physical Activity Questionnaire

Physical Activity was subjectively measured using a modified version of the Paffenbarger Physical Activity Questionnaire which assesses exercise and physical activity.[65] The questionnaire reports average number of flights climbed per day over a 7 day period, time spent brisk walking for exercise or transportation, and time spent in any sport, fitness or recreational activity over the past week. In addition, it assesses in general how often an individual engages in activity similar to brisk walking. These values were converted into kilocalorie scores as defined by Paffenbarger and colleagues.[65]

3.4.3 Eating Behavior Inventory

The Eating Behavior Inventory (EBI) is a self-report questionnaire that was used to assess eating behaviors that are conducive to weight management.[66] The EBI consists of 26 items that assess both adaptive and maladaptive behaviors that have been theoretically implicated in weight loss using a 5-point frequency scale from never or hardly ever to always or almost always. Example items include questions related to portion control, self-monitoring, emotional eating responses, weighing daily, etc. The maladaptive items are reversed scored such that higher scores on the EBI indicate a behavioral pattern that would be conducive to weight loss. The EBI has been shown to be consistently sensitive to behavioral weight management interventions.[66]

3.4.4 Diet History Questionnaire

The Diet History Questionnaire (DHQ) is a cognitively based food frequency questionnaire developed by the National Cancer Institute that was used to assess the frequency of food intake and portion sizes of food intake.[67] The DHQ provides data on energy intake and macronutrient composition. The DHQ has been shown to be a valid measure of estimating absolute intakes, performing best overall when compared to the Block and Willett Food Frequency questionnaires.[67]

3.4.5 Valued Living Questionnaire

The Valued Living Questionnaire (VLQ) is a two-part instrument used to assess valued living.[59, 68, 69] The first part of the questionnaire was used to assess the core values of each individual and was slightly modified for the purposes of this ancillary study. Participants were instructed to rank order the importance of 10 domains which include family (other than parenting and intimate relations), marriage/couples/intimate relations, parenting, friendship, work, education, reaction, spirituality, citizenship, and physical self-care with 1 being the most important. The questionnaire was designed to remove conventional constraints and therefore participant instructions emphasized that not everyone values all of the domains and some areas may be more important than others. This part of the questionnaire identified the domains of living an individual chooses to value as a particular behavioral pattern.[69] Due to the novelty of this questionnaire there is little data on validity, however, this project hoped to contribute and expand the literature with its use in a weight control study. The Valued Living Questionnaire can be found in Appendix A.

3.4.6 Perception of Weight Loss and Behavior on Values Questionnaire

Novel to this project is the creation use of the Perception of Weight Loss and Behaviors on Values Questionnaire for use within a standard behavioral weight loss intervention. This questionnaire was designed to elicit whether individuals perceive that engaging in a weight loss intervention, a calorie restricted diet, modifying eating behaviors, and being physical activity to lose weight will impact their core value and to what extent these actions will impact their core values.

Participants were instructed to write their top three values and consider these values as they answered four questions. The four questions are as follows: (A) How do you perceive that engaging in a weight loss intervention will impact this value? (B) How do you perceive that engaging in a calorie restricted diet to lose weight will impact this value? (C) How do you perceive that engaging in strategies to assist in modifying your eating behaviors will impact this value? (D) How do you perceive that engaging in physical activity to lose weight will impact this value? For each question participants used a Likert scale where 1 = the value will be hindered or negatively impacted, 4 = the value will not be impacted, and 7 = the value will be enhanced or positively impacted to assess the extent to which they perceived these actions impacted their values. An example of the Perception of Weight Loss and Behaviors on Values Questionnaire can be found in Appendix B-D. Appendix B represents the version of the questionnaire that was given prior to the weight loss intervention and Appendix C represents the version after 6 months of the weight loss intervention for baseline values. Appendix D represents the version after 6 months of the weight loss intervention for the newly identified values at 6 months. Due to the novelty of this questionnaire there is no validity data; however, the questionnaire has been reviewed by experts in the field and deemed appropriate for the sample population.

3.5 STATISTICAL ANALYSIS

Descriptive statistics were computed to examine participant characteristics and to identify the value systems among individuals enrolling in a standard behavioral weight loss program. Spearman correlation coefficients were computed to determine the relationship between the baseline and 6-month perception of weight loss and behaviors on values score, and change in weight, eating behaviors, and physical activity

The entire sub-sample of the parent study was utilized to examine the association of the level of perception of weight loss and behaviors on values, weight, and eating behaviors. When examining changes in physical activity, only the groups that were asked to change physical activity were utilized in the statistical analysis. The level of significance for all analyses was set *a-priori* at $p<0.05$. Statistical analyses were conducted using version 22.0 of the IBM Statistical Package for the Social Sciences (SPSS) software (IBM co., Armonk, NY).

3.6 POWER ANALYSIS

The ancillary study utilized a sub-sample of 67 participants that were recruited for the parent study. However, 58 participants provided complete data at both baseline and 6 months, resulting in a retention rate of 86.6%. A power analysis (G*Power 3.1.2) was performed and it was found that this sample would be able to detect a correlation of 0.36 with power of 0.80 and alpha of 0.05. Thus, the correlations observed in this study were not of the magnitude that could be significantly detected with the sample size available.

4.0 RESULTS

There was a total of 67 participants that completed baseline measurements; however, only 58 participants provided data on values at 6 months. Demographic information for participants that completed assessments at baseline and 6 months are included in Table 1. There was a significant reduction in body weight (kg), BMI (kg/m^2), and dietary intake (kcal/day) from baseline to 6 months. There was also a significant increase in physical activity (kcal/week) and EBI score from baseline to 6 months.

Table 1. Demographic characteristics of study participants.

	Total Sample (N=67)	**Subjects with Complete Data (N=58)**	
Variable	**Baseline**	**Baseline**	**6 Months**
Age (years)#	44.2±9.0	43.9±9.2	-----
Height (cm)#	165.5±7.6	165.7±7.8	-----
Weight (kg)#	89.6±14.8	90.1±15.2	80.8±13.6*
BMI (kg/m^2)#	32.6±3.9	32.6±4.0	29.3±4.0*
Dietary Intake (kcal/day)#	1842.8±893.7	1849.4±902.6	1265.6±422.9*
Eating Behavior Inventory#	71.1±9.9	71.4±9.7	87.4±10.9*
Physical Activity (kcal/week)##	564.0 (280.0, 984.0)	580.0 (280.0, 962.3)	990.0 (596.0, 1762.5)*
*Indicates significantly different from baseline at $p \leq 0.001$ #Indicates data presented as Mean ± SD ##Indicates data presented as Median (25^{th} percentile, 75^{th} percentile).			

4.1.1 Frequency of valued living domains

For ease of comprehension and reading, the remainder of the Results and Discussion section will use the word "values" to describe valued living domains. The ranking of the participants' values at baseline and 6 months are shown in Table 2 and 3, respectively. Values were described as family (other than parenting and intimate relations), marriage/couples/intimate relations, parenting, friendship, work, education, reaction, spirituality, citizenship, and physical self-care. At baseline, the three values most frequently identified as the top 1, 2, or 3 domains were marriage/couples/intimate relationships (N=52), family (N=48), and parenting (N=43). These same values remained as the three most frequently identified as the top 1, 2, or 3 domains at 6 months. As shown in Figure 2, 75.9% reported marriage/couples/intimate relationships, 60.3% reported family, and 56.9% reported parenting as values 1, 2, or 3 at both baseline and 6 months. The frequencies of the responses for the perceptions questionnaires can be found in Appendices E-H.

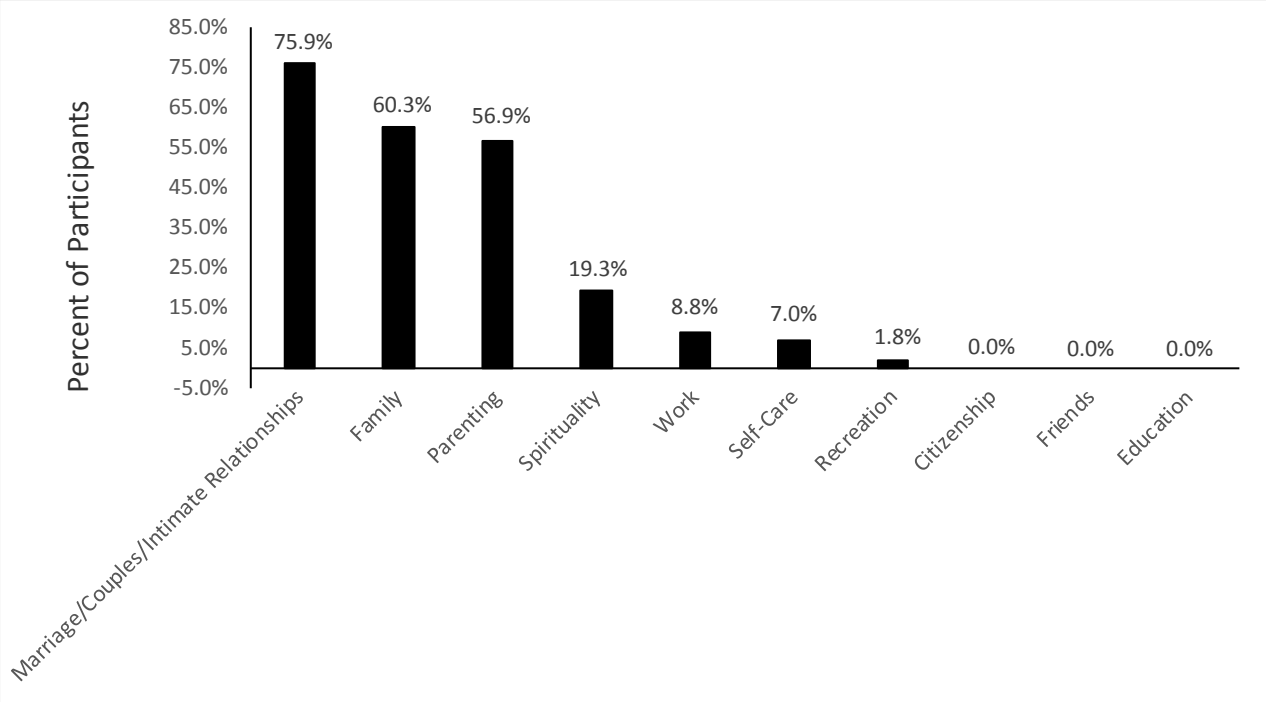
Table 2. Frequency (n) of the valued living domains at baseline (N=67)

	Value Domain 1	***Value Domain 2***	***Value Domain 3***	***Ranked as Value Domain 1, 2, or 3***
Marriage/Couples/Intimate Relationships	13	29	10	52
Family	15	12	21	48
Parenting	21	13	9	43
Spirituality	13	0	3	16
Friends/Social Life	1	3	7	11
Personal Self-Care	3	3	3	9
Work	1	3	5	9
Education/Training	0	3	2	5
Recreation/Fun	0	0	5	5
Citizenship	0	1	1	2
Pets	0	0	1	1
Missing Data	0	0	0	0

Table 3. Frequency (n) of the valued living domains at 6 months (N=58)

	Value Domain 1	***Value Domain 2***	***Value Domain 3***	***Ranked as Value Domain 1, 2, or 3***
Marriage/Couples/Intimate Relationships	11	24	11	46
Family	14	11	19	44
Parenting	20	12	6	38
Spirituality	9	1	3	13
Personal Self-Care	2	4	6	12
Friends/Social Life	0	4	4	8
Work	2	1	5	8
Recreation/Fun	0	1	2	3
Education/Training	0	0	2	2
Citizenship	0	0	0	0
Pets	0	0	0	0
Missing Data	9	9	9	

Figure 2. Percent of participants (N= 58) who identified each of the values as their highest 1, 2, or 3 ranked value at both assessment periods. For example, 60.3% of participants indicated family as one of the 3 highest domains at baseline and then again identified family as one of the 3 highest domains at 6 months.



4.1.2 Interpreting Correlation Coefficients

The correlation coefficients presented in Tables 4-11 include data for change in weight, caloric intake, weight loss related eating strategies and physical activity. Data with change in weight and caloric intake were computed as 6-month value minus baseline value such that a negative value represents a reduction in weight and caloric intake at 6 months. Therefore, a negative correlation with weight would represent a reduction in weight and a perception that engaging in a weight loss intervention would have a positive impact on participants identified values. Similarly, a negative correlation with caloric intake would represent reduced caloric intake among participants and a perception that engaging in a reduced caloric diet would have a positive impact on their identified values. Data with change in weight loss related eating strategies and physical activity were computed as 6-month value minus baseline value such that a positive value represents an improvement in weight loss related eating strategies and increased physical activity at 6 months. Therefore, a positive correlation for weight loss related eating strategies would represent an improvement in these strategies and a perception that engaging in weight loss related eating strategies would have a positive impact on participants identified values. Likewise, a positive correlation with physical activity would represent increased physical activity among participants and a perception that engaging in physical activity would have a positive impact on their identified values.

4.1.3 Correlations between weight loss and perceived impact of engaging in weight loss efforts on valued living domains

To examine the relationship between the perception of whether engaging in a weight loss intervention will have an impact on values and change in weight spearman correlation

coefficients were computed. Data for the highest ranked values identified at baseline are shown in Table 4. When values were identified at baseline, there was no significant relationship between the perceived impact of engaging in a weight loss intervention on these values at baseline and absolute or percent weight change at 6 months. When these values were examined at 6 months, there was no significant relationship between the perceived impact of engaging in a weight loss intervention on values at 6 months and absolute or percent weight change. For the values identified at 6 months, there were also no significant relationships between the perceived impact of engaging in a weight loss intervention on values and absolute or percent weight change at 6 months (Table 5).

Table 4. Spearman correlation coefficients between participants' perceptions of the impact engaging in a weight loss intervention will have on their valued living domains and change in weight from baseline to six months

		Change in Weight (kg)		***Change in Weight (%)***	
Valued Living Domain Identified at Baseline		Correlation Coefficient	P-Value	Correlation Coefficient	P-Value
Domain Ranked 1st at Baseline	Perception of Weight Loss Intervention at Baseline	.031	.820	.094	.484
	Perception of Weight Loss Intervention at 6 month	-.058	.667	-.024	.859
Domain Ranked 2nd at Baseline	Perception of Weight Loss Intervention at Baseline	.139	.269	.166	.214
	Perception of Weight Loss Intervention at 6 month	-.174	.191	-.155	.245
Domain Ranked 3rd at Baseline	Perception of Weight Loss Intervention at Baseline	.145	.277	.166	.212
	Perception of Weight Loss Intervention at 6 month	-.017	.899	.014	.916

Table 5. Spearman correlation coefficients between participants' perceptions of the impact engaging in a weight loss intervention had on their valued living domains and change in weight at 6 months

		Change in Weight (kg)		***Change in Weight (%)***	
Valued Living Domain Identified at 6 Months		Correlation Coefficient	P-Value	Correlation Coefficient	P-Value
Domain Ranked 1st at 6 Months	Perception of Weight Loss Intervention at 6 months	-.036	.788	-.016	.907
Domain Ranked 2nd at 6 months	Perception of Weight Loss Intervention at 6 months	-.131	.328	-.138	.300
Domain Ranked 3rd at 6 Months	Perception of Weight Loss Intervention at 6 months	-.109	.415	-.050	.709

4.1.4 Correlations between change in energy intake and perceived impact of engaging in a reduced calorie diet on valued living domains

To examine the relationship between the perception of whether engaging in a reduced calorie diet will have an impact on values and change in energy intake (kcal/day), spearman correlation coefficients were computed. Data for the highest ranked values identified at baseline are shown in Table 6. When values were identified at baseline, there was no significant relationship between the perceived impact of engaging in a reduced calorie diet on these values and change in energy intake (kcal/day) at 6 months. When these same values were examined at 6 months, there was no significant relationship between perceived impact of engaging in a reduced calorie diet on these values at 6 months and change in energy intake (kcal/day). For the values identified at 6 months, there were also no significant relationships between the perceived impact of engaging in a reduce calorie diet on values and change in energy intake (kcal/day) at 6 months (Table 7).

Table 6. Spearman correlation coefficients between participants' perception of the impact engaging in a reduced calorie diet will have on their valued living domains and change in energy intake (kcal/day) from baseline to six months

		Change in Energy Intake (kcal/day)	
Valued Living Domain Identified at Baseline		Correlation Coefficient	P-Value
Domain Ranked 1st at Baseline	Perception of Reduced Calorie Diet at Baseline	.021	.874
	Perception of Reduced Calorie Diet at 6 month	-.109	.417
Domain Ranked 2nd at Baseline	Perception of Reduced Calorie Diet at Baseline	.117	.385
	Perception of Reduced Calorie Diet at 6 month	-.094	.485
Domain Ranked 3rd at Baseline	Perception of Reduced Calorie Diet at Baseline	-.076	.572
	Perception of Reduced Calorie Diet at 6 month	.016	.907

Table 7. Spearman correlation coefficients between participants' perception of the impact engaging in a reduced calorie diet had on their valued living domains and change in energy intake (kcal/day) from baseline to six months

		Change in Energy Intake (kcal/day)	
Valued Living Domain Identified at 6 Months		Correlation Coefficient	P-Value
Domain Ranked 1st at 6 Months	Perception of Reduced Calorie Diet at 6 month	-.176	.191
Domain Ranked 2nd at 6 months	Perception of Reduced Calorie Diet at 6 month	-.165	.220
Domain Ranked 3rd at 6 Months	Perception of Reduced Calorie Diet at 6 month	.159	.236

4.1.5 Correlations between change in engagement in weight loss-related eating strategies and perceived impact of engaging in weight loss-related eating behaviors on valued living domains

To examine the relationship between the perception of whether engaging in a weight loss related eating strategies will have an impact on values and change in weight loss-related eating strategies as measured by the change in EBI score from baseline to 6-month, spearman correlation coefficients were computed. Data for the highest ranked values identified at baseline

are shown in Table 8. When values were identified at baseline, there was no significant relationship between the perceived impact of engaging in a weight loss-related eating strategies on these values and change in weight loss-related eating strategies. When these same values were examined at 6 months, there was no significant relationship between the perceived impact of engaging in weight loss-related eating strategies on these values at 6 months and change in weight loss-related eating strategies. For the values identified at 6 months, there were also no significant relationships between the perceived impact of engaging in weight loss-related eating strategies on values and change in weight loss-related eating strategies at 6 months (Table 9).

Table 8. Spearman correlation coefficients between participants' perception of the impact engaging in weight loss-related eating strategies will have on their valued living domains and change in weight loss-related eating strategies from baseline to six months

		Change in Weight Loss-Related Eating Strategies	
Valued Living Domain Identified at Baseline		Correlation Coefficient	P-Value
Domain Ranked 1st at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	-.145	.283
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	-.052	.704
Domain Ranked 2nd at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	.074	.584
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	.220	.100
Domain Ranked 3rd at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	.007	.961
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	-.002	.989

Table 9. Spearman correlation coefficients between participants' perception of the impact engaging in weight loss-related eating strategies had on their valued living domains and change in weight loss-related eating strategies at six months

		Change in Weight Loss-Related Eating Strategies	
Valued Living Domain Identified at 6 Months		Correlation Coefficient	P-Value
Domain Ranked 1st at 6 Months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	-.013	.921
Domain Ranked 2nd at 6 months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	-.068	.6148
Domain Ranked 3rd at 6 Months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	.105	.435

4.1.6 Correlations between change in physical activity and perceived impact of engaging in physical activity on valued living domains

To examine the relationship between the perception of whether engaging in physical activity will have an impact on values and change in physical activity (kcal/week), spearman correlation coefficients were computed. Data for the highest ranked values identified at baseline are shown in Table 10. When values were identified at baseline, there was no significant relationship between the perceived impact of engaging in physical activity on these values and change in physical activity (kcal/week) at 6 months. When these same values were examined at 6 months, there was no significant relationship between the perceived impact of engaging in physical activity on these values at 6 months and change in physical activity (kcal/week). For the values identified at 6 months, there were also no significant relationships between the perceived impact of engaging in physical activity on values and change in physical activity (kcal/week) at 6 months (Table 11).

Table 10. Spearman correlation coefficients between participants' perception of the impact engaging in a physical activity will have on their valued living domains and change in physical activity from baseline to six months

Valued Living Domain Identified at Baseline		***Change in Physical Activity (kcal/week)***			
		N=58		**N=37 (Exercise Groups Only)**	
		Correlation Coefficient	P-Value	Correlation Coefficient	P-Value
Domain Ranked 1st at Baseline	Perception of Engaging in Physical Activity at Baseline	-0.086	0.520	0.017	0.922
	Perception of Engaging in Physical Activity at 6 months	-0.069	0.607	-0.029	0.863
Domain Ranked 2nd at Baseline	Perception of Engaging in Physical Activity at Baseline	-0.154	0.2484	-0.136	0.422
	Perception of Engaging in Physical Activity at 6 months	0.203	0.126	0.113	0.507
Domain Ranked 3rd at Baseline	Perception of Engaging in Physical Activity at Baseline	-0.011	0.933	-0.016	0.927
	Perception of Engaging in Physical Activity at 6 months	0.192	0.149	0.154	0.364

Table 11. Spearman correlation coefficients between participants' perception of the impact engaging in a physical activity had on their valued living domains and change in physical activity at six months

Valued Living Domain Identified at Baseline		***Change in Physical Activity (kcal/week)***			
		N=58		**N=37 (Exercise Groups Only)**	
		Correlation Coefficient	P-Value	Correlation Coefficient	P-Value
Domain Ranked 1st at 6 Months	Perception of Engaging in Physical Activity at 6 months	-0.003	0.980	0.066	0.697
Domain Ranked 2nd at 6 months	Perception of Engaging in Physical Activity at 6 months	0.196	0.140	0.098	0.564
Domain Ranked 3rd at 6 Months	Perception of Engaging in Physical Activity at 6 months	0.045	0.738	-0.018	0.916

4.2 SUMMARY

Participants enrolled in a 6-month behavioral weight loss intervention were found to predominantly identify marriage/couples/intimate relationships, family, and parenting as their highest values at baseline and 6 months. Additionally, over half of those participants who identified marriage/couples/intimate relationships, family, and parenting as their top ranked 1, 2, or 3 values at baseline continued to report these values as one of their 3 highest domains at 6 months. Finally, there was no relationship between participants' perception of the impact that engaging in a weight loss intervention would have on their values (measured at baseline and 6

months) and their actual changes in body weight, and related eating and physical activity behaviors. Therefore, our hypotheses were not supported.

5.0 DISCUSSION

5.1 SUMMARY OF APPROACH AND FINDINGS

The current study included individuals enrolled in a 6-month standard behavioral weight management program. A survey was conducted at baseline and 6 months that asked participants to rank order their valued living domains, with this defined as "values" throughout the remainder of this document. In addition, participants' perceptions of the impact that engaging in a weight loss intervention and weight loss related behaviors would have on their identified values were measured. These surveys were administered at baseline and 6 months. We hypothesized that those individuals who perceived that engaging in weight loss related behaviors would positively impact their identified values would be more successful in adhering to the weight loss prescriptions and ultimately lose more weight.

This study found that a large proportion of participants enrolled in the weight loss intervention chose marriage/couples/intimate relationships, family, and parenting as their highest values and those values remained fairly stable over the course of the intervention. However, participants' perceptions of the impact that engaging in a weight loss intervention and weight loss behaviors would have on their core values were not significantly associated with change in weight or weight loss behaviors (eating and physical activity).

5.1.1 Importance of the research question and study findings

In this study we aimed to evaluate a potential predictor of adherence to standard behavioral weight loss recommendations. Adherence to weight loss behavior change strategies is important for weight loss success.[17] The strength of one's motivation for change may be a determinant in the adoption and adherence to weight loss behaviors; however, understanding what motivates an individual to adhere to weight loss prescriptions is currently not understood.[15] Values have been identified as a process for change in several theories and clinical techniques including SDT, MI, and ACT.[18-20] Furthermore, values have been suggested as a construct that should be explored when determining what potentially underlies motivation and adherence among individuals in behavioral weight loss interventions.[17] In the current study, 6-month weight loss and engagement in weight loss behaviors were not associated with participants' perception of the impact that engaging in weight loss related behaviors would have on their personal values. Thus, based on these findings, it appears that participants engaged in a 6-month behavioral weight loss intervention do not link their values to their weight loss efforts, which is not consistent with values-based theories and interventions.

Despite theoretical rationale, values exploration within standard behavioral weight loss interventions has not been extensively examined. Currently, MI strategies suggest that understanding an individual's broader life goals or core values is the key to understanding what motivates an individual and is another way in which to promote engagement in new behaviors.[19] For example, MI Value strategies seek to help individuals identify perceived value-behavior discrepancies which may trigger behavior change as it has been shown that when a behavior comes into direct conflict with an individual's core values, it is usually the behavior that changes.[19] It has also been suggested that ACT constructs may aid individuals in the

adoption of healthy behaviors that are consistent with an individual's stated values. Therefore, if individuals link their weight loss efforts to values this may enhance adherence and engagement, and this may result in successful weight loss.[24] These strategies may also suggest that in order for a value to be associated with weight loss success it should be targeted within interventions. However, little is known about whether individuals will link weight loss related behaviors to identified core values and whether that linkage is connected to increased adherence to weight loss behaviors. The current investigation sought to examine whether this linkage may in fact exist within a standard behavioral weight loss intervention without targeting values as a key strategy, and no such associations were found.

An example of a study that included values as a key strategy within a weight loss intervention was implemented in overweight and obese adolescents.[58] Participants were randomized to either an MI Values multidisciplinary treatment or education control multidisciplinary treatment.[58] The participants in the MI Values group completed two MI values sessions that included a values clarification exercise in which participant's selected their top five values and were instructed to explore the relationship between these values and their target behavior. Additionally, they worked with clinicians to identify discrepancies between their values and current behavior in order to increase readiness to change.[58] When compared with controls, the MI values group had increased treatment adherence at both 3 and 6 months.[58] In contrast, the results of the current investigation suggest that regardless of whether an individual perceives engaging in a weight loss intervention will either positively or negatively impact their core values may not be related to weight loss or related eating and physical activity behaviors.

An example of a study that utilized values as a key strategy to increase physical activity was done by Kangasniemi, et al. A feedback-only control was compared to an ACT group that

sought to enhance physical activity through life values and committed action based on the chosen values.[70] Physical activity measured both objectively (3 months) and subjectively (6 months) significantly improved across time; however, this increase in physical activity was not different from the control group. Furthermore, the ACT group that received targeted values exploration for engagement in physical activity showed greater improvement in adoption self-efficacy, self-efficacy when facing the barriers of exercise, and acceptance of psychological and physical discomfort related to physical activity over time compared to the control group. This suggests that for values to positively impact adherence to weight loss strategies, interventions may need to explore how weight loss behaviors such as physical activity can support participants' core values. It is possible that similar results were not seen in the current investigation because exploring how physical activity can support important values was not a target of the intervention.

Beyond targeting values within an intervention as a means to improve adherence, it is possible that affirming values can lead to behavior change and improved weight loss outcomes. This was shown in a recent study that instructed participants to select a value that was most important to them and write about why it was important.[71] No other instructions were given. The comparison group was instructed to write about why their 9th ranked value might be important to someone else. Participants were then asked to return 2.5 months later for weight, BMI, and waist circumference measurements.[71] Participants in the values affirmation group lost weight and reduced their BMI, whereas those in the comparison group increased weight and BMI.[71] In contrast, the current investigation did not ask participants to write why values were important; however, they were asked to determine their top 3 values and identify the impact that engaging in a weight loss intervention would have on those values. Also our investigation did not show any correlation to weight change over time. This discrepancy could be related to the

difference between the ways in which values were affirmed. The current investigation did not have participants reflect on why values were important but rather simply rank values in order of importance. Therefore, a strategy may be to spend time clearly defining the importance of their identified values in order to have an impact on weight.

Of particular interest is that a large proportion of participants enrolled in the current weight loss intervention chose marriage/couples/intimate relationships, family, and parenting as their highest values and those values remained fairly stable over the course of the intervention. Therefore, it appears that engaging in a weight loss intervention does not seem to alter an individual's core values regardless of whether they perceived this engagement would positively or negatively impact these core values. This is an important finding that may inform future weight loss interventions. This stability of values over time suggests that the intervention should focus on engaging individuals in the exploration of the inherent relationship between their core values and participation in healthy eating, physical activity, and weight loss behaviors, rather than concentrating on instilling new values or re-prioritizing values such as "self-care." This targeted approach would allow for a personalized intervention that may instill intrinsic motivation to participate in the desired behaviors necessary for weight loss.

In summary, no associations were found between the perception of the impact that engaging in weight loss related strategies would have on highest ranked values and weight change, caloric intake, eating behaviors, or physical activity. A large proportion of participants enrolled in the weight loss intervention chose marriage/couples/intimate relationships, family, and parenting as valued living domains and those valued living domains remained fairly stable over the course of the intervention.

5.1.2 Limitations and Future Directions

There were limitations to this study that may have influenced the results.

1. The primary questionnaires utilized within this study have not been administered in a standard behavioral weight loss intervention before and therefore did not have supporting evidence for psychometric properties within this population. Thus, future studies should seek to establish validity and reliability for these questionnaires within this population.
2. Values were broadly defined in the administered questionnaire. Therefore, participants could have differed in their perception of each value. Future studies are warranted to determine whether value domains should be described in more detail.
3. The Valued Living Questionnaire utilized in this study gave 10 specific domains with the option for individuals to write in their own "other" category; however, only one participant used the "other" option as a response. It is possible that distributing a defined set of values resulted in core values being excluded. Future studies should seek to thoroughly define values among individuals entering into a standard weight loss intervention, possibly by asking participants to write out their core values rather than rank ordering a pre-determined list of values.
4. The outcomes related to weight loss behaviors (caloric intake, eating behaviors, and physical activity) were self-reported, which may have impacted the accuracy of these measures. Future studies should seek to utilize objectively measured outcome data where available.

5. Individuals perception of the impact that engaging in weight loss related strategies would have on their values was measured over the first 6 months of a standard behavioral intervention, which is often a more intensive phase of the weight loss intervention. Thus, the results of this study may not apply to weight loss interventions that extend beyond 6 months. Future studies should examine these relationships for longer periods across these types of interventions.

5.1.3 Conclusion

The current study expands the literature examining how values may be associated with response to a short-term weight loss intervention. This study found no significant association between either weight loss or weight loss related behaviors (eating, physical activity) and participants' perception of how these efforts impacted values of participants. This does not appear to be consistent with theories that have suggested that values can be important to elicit health behavior changes. These findings do not indicate that values-based interventions will not be effective for weight loss; however, additional research is needed in this area using appropriately designed and adequately powered studies. This study did, however, find that values remained relatively stable across the weight loss intervention period. Thus, this may suggest that values-based interventions may need to link participant's current values to desired health outcomes rather that attempting to alter the things in one's life that are valued within interventions. These important research questions require further investigation before broad implementation within clinical approaches for weight control and behavior change.

APPENDIX A

Valued Living Questionnaire

Below are areas of life that are valued by some people.

- Place these in rank order with "1" being the most important, "2" being the second most important, etc. for your life.
- Rank each area according to **your own personal sense of importance**.

Area	**Ranking**
Family (other than marriage or parenting)	_____
Marriage/couples/intimate relations	_____
Parenting	_____
Friends/social life	_____
Work	_____
Education/training	_____
Recreation/fun	_____
Spirituality	_____
Citizenship/Community Life	_____
Physical self-care	_____
Other: _____ (describe)	_____

APPENDIX B

PERCEPTION OF WEIGHT LOSS AND BEHAVIORS ON WEIGHT LOSS (TO BE COMPLETED PRIOR TO ENGAGING IN A WEIGHT LOSS PROGAM)

Figure 3. Perception of Weight Loss and Behaviors on Weight Loss Questionnaire

1. List the value you ranked as #1 on the "Valued Living Questionnaire" here: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value will be hindered or negatively impacted ↓		The value will not be impacted ↓			The value will be enhanced or positively impacted ↓	
	1	2	3	4	5	6	7
a. How do you perceive that engaging in a weight loss intervention will impact this value?							
b. How do you perceive that engaging in a calorie restricted diet to lose weight will impact this value?							
c. How do you perceive that engaging in strategies to assist in modifying your eating behaviors will impact this value?							
d. How do you perceive that engaging in physical activity to lose weight will impact this value?							

2. List the value you ranked as #2 on the "Valued Living Questionnaire" here: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value will be hindered or negatively impacted ↓		The value will not be impacted ↓			The value will be enhanced or positively impacted ↓	
	1	2	3	4	5	6	7
a. How do you perceive that engaging in a weight loss intervention will impact this value?							
b. How do you perceive that engaging in a calorie restricted diet to lose weight will impact this value?							
c. How do you perceive that engaging in strategies to assist in modifying your eating behaviors will impact this value?							
d. How do you perceive that engaging in physical activity to lose weight will impact this value?							

3. List the value you ranked as #3 on the "Valued Living Questionnaire" here: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value will be hindered or negatively impacted ↓			The value will not be impacted ↓			The value will be enhanced or positively impacted ↓
	1	2	3	4	5	6	7
e. How do you perceive that engaging in a weight loss intervention will impact this value?							
f. How do you perceive that engaging in a calorie restricted diet to lose weight will impact this value?							
g. How do you perceive that engaging in strategies to assist in modifying your eating behaviors will impact this value?							
h. How do you perceive that engaging in physical activity to lose weight will impact this value?							

APPENDIX C

PERCEPTION OF WEIGHT LOSS AND BEHAVIORS ON WEIGHT LOSS (TO BE COMPLETED AFTER COMPLETING 6 MONTHS OF THE WEIGHT LOSS PROGRAM FOR VALUES IDENTIFIED AT BASELINE)

Figure 4. Perception of Weight Loss and Behaviors on Weight Loss Questionnaire

1. The value you ranked as #1 on the "Valued Living Questionnaire" prior to starting the weight loss program was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

2. The value you ranked as #2 on the "Valued Living Questionnaire" prior to starting the weight loss program was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

3. The value you ranked as #3 on the "Valued Living Questionnaire" prior to starting the weight loss program was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

APPENDIX D

PERCEPTION OF WEIGHT LOSS AND BEHAVIORS ON WEIGHT LOSS (TO BE COMPLETED AFTER COMPLETING 6 MONTHS OF THE WEIGHT LOSS PROGRAM FOR VALUES IDENTIFIED AT 6 MONTHS)

Figure 5. Perception of Weight Loss and Behaviors on Weight Loss Questionnaire

1. The value you ranked as #1 on the "Valued Living Questionnaire" you just completed was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

2. The value you ranked as #2 on the "Valued Living Questionnaire" just completed was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

3. The value you ranked as #3 on the "Valued Living Questionnaire" you just completed was: _____

Please use the scale to the right when responding to each of the statements below. Place an "X" in the box that corresponds to your response.	The value was hindered or negatively impacted ↓			The value was not impacted ↓			The value was enhanced or positively impacted ↓
	1	2	3	4	5	6	7
a. How do you perceive that your engagement in a weight loss intervention impacted this value?							
b. How do you perceive that your engagement in a calorie restricted diet to lose weight impacted this value?							
c. How do you perceive that your engagement in strategies to assist in modifying your eating behaviors impacted this value?							
d. How do you perceive that your engagement in physical activity to lose weight impacted this value?							

APPENDIX E

Table 12. Frequency of responses for perceptions of the impact engaging in a weight loss intervention will have, or had, on participants' valued living domains (N=58)

		Likert Scale Response						
Valued Living Domain Identified at Baseline		1	2	3	4	5	6	7
Domain Ranked 1st at Baseline	Perception of Weight Loss Intervention at Baseline	0	0	1	10	6	12	29
	Perception of Weight Loss Intervention at 6 month	0	1	1	20	8	10	18
Domain Ranked 2nd at Baseline	Perception of Weight Loss Intervention at Baseline	0	1	2	13	9	11	22
	Perception of Weight Loss Intervention at 6 month	0	2	0	17	11	13	15
Domain Ranked 3rd at Baseline	Perception of Weight Loss Intervention at Baseline	0	1	2	18	11	10	16
	Perception of Weight Loss Intervention at 6 month	0	0	3	20	12	12	11

Table 12 (continued)

		Likert Scale Response						
Valued Living Domain Identified at 6 Months		1	2	3	4	5	6	7
Domain Ranked 1st at 6 Months	Perception of Weight Loss Intervention at 6 months	0	0	1	16	8	15	18
Domain Ranked 2nd at 6 months	Perception of Weight Loss Intervention at 6 months	0	1	1	12	16	14	14
Domain Ranked 3rd at 6 Months	Perception of Weight Loss Intervention at 6 months	0	0	1	22	9	13	13

APPENDIX F

Table 13. Frequency of responses for perceptions of the impact engaging in a reduce caloric diet will have, or had, on participants' valued living domains (N=58)

		Likert Scale Response						
Valued Living Domain Identified at Baseline		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at Baseline	Perception of Reduced Calorie Diet at Baseline	0	3	7	17	9	9	13
	Perception of Reduced Calorie Diet at 6 month	1	0	2	21	14	9	11
Domain Ranked 2nd at Baseline	Perception of Reduced Calorie Diet at Baseline	0	2	5	17	8	13	13
	Perception of Reduced Calorie Diet at 6 month	0	1	3	25	9	12	8
Domain Ranked 3rd at Baseline	Perception of Reduced Calorie Diet at Baseline	1	5	5	21	10	8	8
	Perception of Reduced Calorie Diet at 6 month	0	1	4	26	8	12	7

Table 13 (continued)

		Likert Scale Response						
Valued Living Domain Identified at 6 Months		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at 6 Months	Perception of Reduced Calorie Diet at 6 month	0	0	3	20	13	12	10
Domain Ranked 2nd at 6 months	Perception of Reduced Calorie Diet at 6 month	0	2	3	21	10	12	10
Domain Ranked 3rd at 6 Months	Perception of Reduced Calorie Diet at 6 month	0	0	2	25	11	10	10

APPENDIX G

Table 14. Frequency of responses for perceptions of the impact engaging in weight loss related eating strategies will have, or had, on participants' valued living domains (N=58)

		Likert Scale Response						
Valued Living Domain Identified at Baseline		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	0	1	5	13	9	15	15
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	1	0	1	21	14	9	12
Domain Ranked 2nd at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	0	1	2	18	7	14	16
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	1	4	18	16	8	11
Domain Ranked 3rd at Baseline	Perception of Engaging in Weight Loss-Related Eating Strategies at Baseline	0	3	6	21	9	11	8
	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	2	2	22	15	10	7

Table 14 (continued)

		Likert Scale Response						
Valued Living Domain Identified at 6 Months		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at 6 Months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	0	2	16	15	13	12
Domain Ranked 2nd at 6 months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	1	3	14	18	12	10
Domain Ranked 3rd at 6 Months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	0	3	23	11	9	12

APPENDIX H

Table 15. Frequency of responses for perceptions of the impact engaging in a physical activity will have, or had, on participants' valued living domains (N=58)

		Likert Scale Response						
Valued Living Domain Identified at Baseline		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at Baseline	Perception of Engaging in Physical Activity at Baseline	0	0	2	9	8	14	25
	Perception of Engaging in Physical Activity at 6 months	0	0	2	22	10	9	15
Domain Ranked 2nd at Baseline	Perception of Engaging in Physical Activity at Baseline	0	1	2	18	11	10	16
	Perception of Engaging in Physical Activity at 6 months	0	2	1	18	13	11	13
Domain Ranked 3rd at Baseline	Perception of Engaging in Physical Activity at Baseline	0	1	3	20	9	9	16
	Perception of Engaging in Physical Activity at 6 months	0	0	4	22	12	11	9

Table 15 (continued)

		Likert Scale Response						
Valued Living Domain Identified at 6 Months		**1**	**2**	**3**	**4**	**5**	**6**	**7**
Domain Ranked 1st at 6 Months	Perception of Engaging in Physical Activity at 6 months	0	0	2	17	10	14	15
Domain Ranked 2nd at 6 months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	1	1	16	15	11	14
Domain Ranked 3rd at 6 Months	Perception of Engaging in Weight Loss-Related Eating Strategies at 6 months	0	0	1	26	12	8	11

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